What is Claimed is:

1. A method of controlling the crystalline structure of ingots and castings of ferrous and non-ferrous metals, in which the melt is crystallized in helically traveling magnetic fields excited by *m*-phase systems of helical alternating currents, wherein said currents are hierarchically frequency- and amplitude-modulated, wherein said modulation is superimposed on said *m*-phase systems of currents in the form of pulses with a certain periodically repeated duration in time.

2. A method of controlling the crystalline structure according to claim 1, wherein said systems of currents frequency- and amplitude-modulated by said method are periodically switched on for a certain time interval and switched off with a certain time interval.

3. A method of controlling the crystalline structure according to claim 1 or 2, wherein in the process of continuous or semi-continuous casting, amplitude modulation depth and frequency deviation are periodically changed in time.

4. A method of controlling the crystalline structure according to claim 1 or 2, wherein in the process of casting stationary ingots and castings, amplitude modulation depth and frequency deviation are growing with increasing thickness of the crystallizing solid phase.

5. A method of continuous out-of-furnace purification of ferrous metals melts from detrimental impurities, wherein the melt flowing along a long lined pipe is mixed with an alloying additive or with reagent under the action of helically traveling magnetic fields excited by *m*-phase systems of helical currents, wherein said currents are frequency- and amplitude-modulated by periodically changing in time sufficiently arbitrary functions, wherein said amplitude modulation is periodically changed along the pipe axis.

6. A method according to claim 5, wherein said amplitude modulation depth is varying along the pipe axis.

7. A method according to claim 5 or 6, wherein the frequency modulation deviation is changed along the pipe axis.

8. A facility for continuous out-of-furnace purification of ferrous metals melts from detrimental impurities, comprising a lined pipe with a receiving cone and a ladle lip, a supporting frame, a hopper with reagents, a generator of said modulated currents and explicit-pole system of discrete coils within a stirrer, inductors exciting a helically traveling magnetic field modulated by said method, wherein the inductors are built into a lining of the lined pipe, and magnetic circuits of said inductors are made of ferroceramics.

9. A facility according to claim 8, wherein the poles of said inductors are built into the lining, and the back of the magnetic circuit made of common laminated transformer steel is placed outside the body of said pipe.

10. A facility according to claim 8 or 9, wherein the coils are made in the form of detachable ceramic boxes fixed on the poles, with helical channels filled with solid or liquid metal with the melting temperature below, and the boiling temperature above the temperature of the surrounding lining.

11. A facility according to claim 8, 9, or 10, wherein said ceramic boxes are made of a common refractory material formed and baked together with the magnetic circuit pole.

12. A facility according to claim 8, 9, 10, or 11 wherein said poles of said inductor are separated from the melt by a refractory layer, whose thickness is determined by the difference between the melt temperature and the Curie temperature of said ferroceramics.

13. A method of intensification of melt stirring in induction m-phase furnaces with a steel core, wherein the currents feeding primary windings of an m-phase furnace transformer are hierarchically frequency and amplitude-modulated.

14. A method according to claim 13, wherein a helically traveling magnetic field excited by an m-phase system of currents synchronously frequency- and/or amplitude-modulated by said functions, wherein said magnetic field is applied after filling with melt 1/n of the final melt height in the shaft.

15. A method according to claim 14, wherein a rotating magnetic field (RMF) modulated in said manner affects the melt produced in electric-arc furnaces and reverberatory furnaces for casting aluminum alloys.

16. An induction furnace with a steel core comprising a lined shaft, lined channel section, furnace transformer, system of air or water cooling of the transformer windings, supporting frame and a mechanism of furnace rotation, wherein the furnace shaft is equipped with an inductor, which is totally or partially built into the lining, whose magnetic circuit is made of ferroceramics with a high Curie temperature.

17. The induction furnace according to claim 16, wherein the inductor coils are made in the form of detachable ceramic boxes with a helical channel filled with metal having melting temperature below the temperature of metal melting in the furnace, and boiling temperature is above the temperature of the metal melting in the furnace.

18. The induction furnace according to claim 17, wherein said ceramic boxes are made of a common refractory material and are formed and baked together with said magnetic circuit poles.

19. I The induction furnace according to claim 17 or 18, wherein said magnetic circuit poles with said coils are placed inside the furnace shaft lining, and the backs of the magnetic circuit are made of laminated transformer steel and fixed to the shaft jacket.

20. The induction furnace according to claim 17, 18, or 19, wherein said poles of said inductor are separated from the melt by a layer of a refractory material, whose thickness is determined by the difference between the melt temperature and the Curie temperature of said ferroceramics.

21. A melting chamber of an electric-arc furnace comprising a jacket, lined cylindrical part, floor and roof, wherein RMF inductor is arranged in the floor lining, with the magnetic circuit of said inductor made of ferroceramics with a high Curie temperature

22. The melting chamber according to claim 21, wherein the inductor coils are made in the form of ceramic boxes filled with metal whose melting temperature is lower, and boiling temperature - higher than the melt temperature in the furnace.

23. A reverberatory furnace for producing aluminum alloys, wherein the magnetic core of said inductor is made of ferroceramics and arranged within the furnace lining, whereas the coils are made in the form of ceramic boxes with helical grooves filled with metal possessing properties mentioned in claim 22.

24. A method of forcing influence upon electroconducting media using helically traveling magnetic fields excited by m-phase systems of helical currents, in which the currents are co-phasally hierarchically frequency- and amplitude-modulated or modulated by amplitude and initial phase by temporally periodic functions that are either continuous or having a finite number of discontinuities of the first kind, smooth or non-smooth in certain points, so that the current in the first phase is described by the expression:

$$J_1 = A_1(t) \cdot F[\Omega_1(t)t + \gamma_0], \qquad (23)$$

in the second phase -

$$J_2 = A_2(t) \cdot F\left[\Omega_2(t)\left(t - \frac{2\pi}{m}\right) + \gamma_0\right], etc. \qquad (24)$$

in the n-th phase -

$$J_n = A_n(t) \cdot F\left[\Omega_n(t)\left(t - \frac{2\pi(n-1)}{m}\right) + \gamma_0\right], \qquad (25)$$

where

$$A_1(t) = A_{10}\{1 + \varepsilon_2[1 + \varepsilon_4 \times \ldots \times (1 + \varepsilon_{2n})] \cdot f_2[\omega_2(1 + \varepsilon_3 f_3(\omega_3 t + \gamma_3))t + \gamma_2]\},$$

$$A_2(t) = A_{10}\left\{1 + \varepsilon_2\left[1 + \varepsilon_4 \times \ldots \times \left(1 + \varepsilon_{2n}\right)\right] \times f_2\left[\omega_2\left(1 + \varepsilon_3 f_3\left(\omega_3\left(t - \frac{2\pi}{m}\right) + \gamma_3\right)\right)t - \gamma_2\right]\right\},$$

...

$$A_n(t) = A_{10}\left\{1 + \varepsilon_2\left[1 + \varepsilon_4 \times \ldots \times \left(1 + \varepsilon_{2n}\right)\right] \times f_2\left[\omega_2\left(1 + \varepsilon_3 f_3\left(\omega_3\left(t - \frac{2\pi(n-1)}{m}\right) + \gamma_3\right)\right)t + \gamma_{2n}\right]\right\},$$

$$\varepsilon_{2n} = \varepsilon_{2n0}\left\{1 + \varepsilon_{2n+2} \times f_{2n+2}\left[\omega_{2n+2}\left(1 + \varepsilon_{2n+1} \times f_{2n+1}\left(\omega_{2n+1}\left(t - \frac{2\pi(n-1)}{m}\right) + \gamma_{2n+1}\right)\right)t + \lambda_{2n+2}\right]\right\},$$

A_{10} is the amplitude of a non-modulated current,

n is the phase number,

p is the number of pole pairs of the inductor,

ε_{2n0} is the relative depth of various levels of amplitude modulation,

ε_{2n+1} is the relative deviation of various levels of frequency modulation,

ω_{2n} is the frequency of various hierarchic levels of amplitude modulation,

ω_{2n+1} is the frequency of various hierarchic levels of frequency modulation,

$$\Omega_n(t) = \Omega_0\left[1 + \varepsilon_1 f_1\left(\omega_1\left(t - \frac{2\pi(n-1)}{m}\right)\right) + \gamma_1\right],$$

Ω_0 is the carrying frequency of either modulated or non-modulated currents,

F, f_{2n}, f_{2n+1} are periodic functions of time,

γ_{2n}, γ_{2n+1} are initial phases.

25. A method of forcing influence upon electroconducting media using helically traveling magnetic fields excited by *m*-phase systems of helical currents, in which the currents are synchronously hierarchically frequency- and amplitude-modulated or modulated by amplitude and initial phase by temporally periodic functions that are either continuous or having a finite number of discontinuities of the first order, so that the currents in the *n*-th phase are described by the expression of claim 24, where:

$$A_n(t) = A_{10}\ \{1+\varepsilon_2[1+\varepsilon_4\ \mathrm{X}\ldots\ \mathrm{X}\ (1+\varepsilon_{2n})]\cdot f_2[\omega_2(1+\varepsilon_3 f_3(\omega_3 t+\gamma_3))\,t+\gamma_2]\} \quad (26)$$

and

$$\varepsilon_{2n} = \varepsilon_{2n0}\,\{1+\varepsilon_{2n+2}\cdot f_{2n+2}[\omega_{2n+2}\,(1+\varepsilon_{2n+1} f_{2n+1}\,(\omega_{2n+1}t+\gamma_2))t+\gamma_{2n+2}]\} \quad (27).$$

26. The method according to claim 24 or 25, wherein the carrying frequency of the system of currents is constant, i.e. $\Omega(t) = \Omega_0 = const.$.

27. The method according to claim 24, 25, or 26, wherein only a rotating magnetic field modulated by said methods is applied.

28. The method according to claim 24, 25, or 26, wherein only an axially traveling magnetic field modulated by said methods is applied.

29. The method according to claim 24, 25, 26, 27, or 28, wherein the conducting medium is affected by two or more identical or different magnetic fields modulated by said methods, propagating in the same or in different directions.

30. The method according to claim 24, 25, 26, 27, 28, or 29, wherein, using a system of km electrodes (where *k* is the number of electrodes per phase), an additional m-phase current density field modulated by said method is introduced into the conducting medium.

31. A method of continuous out-of-furnace alloying of liquid metals in a flow of ferrous metals melts from detrimental impurities, wherein the melt is flowing along a long lined pipe and is mixed with an alloying additive or with reagent under the action of helically traveling magnetic fields excited by *m*-phase systems of helical currents, wherein said currents are frequency- and amplitude-modulated by periodically changing in time functions, wherein said amplitude modulation is periodically changed along the pipe axis.